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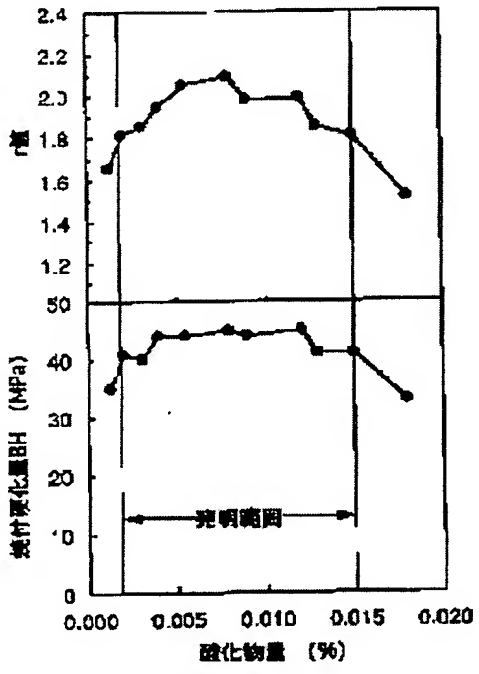
(54) STEEL SHEET FOR DEEP DRAWING, EXCELLENT IN SURFACE CHARACTERISTIC AND BAKING HARDENABILITY, AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a steel sheet excellent in surface characteristic and baking hardenability, and its manufacture.
SOLUTION: The steel sheet contains, by weight, 0.0003-0.010% C, ≤1.0% Si, ≤3.0% Mn, ≤0.15% P, ≤0.05% S, ≤ 0.01% N, 0.010-0.50% Ti, and ≥0.0005% Ca and/or metallic REM and also contains Al in an amount satisfying (1) wt.% Ti/wt.%Al≥5 or (2) Al≤0.010% and wt.%Ti/wt.%Al<5 and further contains 0.005-0.05 wt.% of non-oxide Ti (Ti*). At the time of its manufacture, a slab is heated and soaked at 900 to 1,300°C, finish rolling is finished at 650 to 960°C, coiling is done at 400 to 750'C, cold rolling is carried out at 50 to 95% draft, and the resultant sheet is subjected to recrystallization annealing at 700 to 920°C.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention -- a front face -- the good deep drawing steel and its manufacture approach of description -- being related -- especially -- a front face -- it is related with the steel plates for surface treatment and those manufacture approaches of the steel plate which was excellent also in a moldability and printing hardenability with description, for example, cold rolled sheet steel and a hot-dip zinc-coated carbon steel sheet, an electrolytic zinc-coated carbon steel sheet, a tinning steel plate, an enamel covering steel plate, a paint steel plate, and others. Ti deoxidation especially with suitable this invention -- generation of the oxide system inclusion in steel, i.e., huge cluster-like inclusion, -- controlling -- the front face of a steel plate -- while improving description, by carrying out the detailed decentralization of the inclusion, the grain growth possibility at the time of cold-rolled-annealing tends to be controlled, and it is going to offer the super-low carbon cold rolled sheet steel which comes to improve an r value and printing hardenability.
[0002]
[Description of the Prior Art] Deoxidation of steel was performed by ferrotitanium as indicated by JP,44-18066,B at the beginning. However, in order to manufacture the steel by which the oxygen density was stabilized by low cost in recent years, aluminum killed steel deoxidized with aluminum is in use.
[0003] aluminum deoxidation of steel is aluminum 2O3 in a cast piece in this case, although it is the approach of making condense a generation oxide and carrying out floatation using gas stirring or RH degassing apparatus. An oxide will remain impossibly. And this aluminum 2O3 Since it becomes cluster-like, it is hard to dissociate, and occasionally it is several 100. Thing cluster-like inclusion remains more than mum. It is HEGE if the inclusion of the shape of such a cluster is caught by the cast piece surface section, Since it will lead to surface discontinuity like a sleeve, in the steel plate for automobiles which needs beautiful, it becomes a fatal defect. Moreover, by aluminum deoxidation, it is aluminum 2O3. It adhered to the wall of the immersion nozzle used in order to pour in from a tundish to mold, and there was a problem of causing nozzle lock out.
[0004] They are CaO and aluminum 2O3 by adding calcium to the problem accompanying such aluminum deoxidation mentioned above in the molten steel which carried out aluminum killed. The method of making a multiple oxide generate is proposed. (For example, JP,61-276756,A, JP,58-154447,A, and JP,6-49523,A) . the purpose of calcium addition in this approach -- aluminum 2O3 calcium is reacted -- making -- CaOAl 2O3, 12CaOAl 2O3, and 3CaOAl 2O3 etc. -- it is in the place which is going to conquer the trouble mentioned above by forming a low-melt point point multiple oxide.

[0005] However, if calcium is added into molten steel, this calcium will react with S in steel, CaS will be formed, and this CaS will build the cause of rusting. They are 5 ppm about the amount of calcium which remains in steel in this point and JP,6-559,A in order to prevent rusting. It is 10 ppm above. The approach of making it into the following is proposed. However, it is 10 ppm about the amount of calcium. CaO-aluminum 2O3 which remains in steel even if it makes it the following It is especially CaO when the presentation of a system oxide is not proper. When concentration is 30% or more of oxide, the solubility of S in the oxide increases and CaS generates impossibly in an inclusion inner circumference enclosure at the time of a temperature fall and coagulation. Consequently, the CaS serves as an origin, rust is generated, and it comes to cause front planar degradation of a product plate. Moreover, if surface treatment like plating or paint is performed with such a rusting point remained, surface nonuniformity will surely occur after processing. on the other hand, CaO in inclusion concentration -- 20% or less -- low -- and aluminum 2O3 case concentration is high -- especially -- aluminum 2O3 not only becoming easy to generate nozzle plugging at the time of continuous casting, since the melting point of inclusion goes up and it becomes easy to sinter inclusion, when concentration is 70% or more but a steel plate front face -- HEGE, a sleeve etc. -- generating -- a front face -- there was a problem of worsening description remarkably.
[0006] On the other hand, it continues till recent years and the approach of deoxidizing by Ti is developed as JP,8-239731,A, without adding aluminum. A cluster-like oxide is not generated although the amount of inclusion has many attainment oxygen densities highly compared with the aluminum deoxidizing method as for the approach of such aluminum loess Ti deoxidation. The gestalt of the inclusion generated especially is Ti oxide-aluminum 2O3. It becomes a system and the condition that the about 2-50-micrometer granular oxide distributed is presented. Therefore, the surface discontinuity resulting from inclusion becoming cluster-like mentioned above decreases. However, when Ti concentration became more than 0.010 wt% by aluminum<=0.005 wt% molten steel in this Ti deoxidation, Ti oxide of a solid phase condition carried out accretion to the inside of a tundish nozzle in the form where the metal was incorporated, and there was a new problem of inducing lock out of a nozzle on the contrary.
[0007] Such a problem (lock out prevention of a nozzle) Ti 2O3 which grows up to be a nozzle inside by restricting the amount of oxygen of the molten steel which passes a nozzle in aluminum loess Ti killed steel in JP,8-281391,A in order to solve The approach of preventing growth is proposed. However, since there is a limitation also in a limit of the amount of oxygen in the case of this approach, throughput is restricted (about 800t). There was another problem to say. Moreover, since the level control of the surface of hot water in mold becomes unstable with advance of lock out, the actual condition is not fundamental solution.
[0008] Moreover, the technique of the indication to this JP,8-281390,A is Ti 2O3 which grows up to be a nozzle inside by rationalizing Si concentration of molten steel and making an inclusion presentation into Ti3O5-SiO2 system as a lock out preventive measure of a tundish nozzle. The approach of preventing growth is proposed. However, it is even if it is difficult and few to make SiO2 contain in inclusion, even if it only increases Si concentration. (wt%Si) /(wt%Ti) > It must be made to have to satisfy 50. Therefore, when Ti concentration in steel is 0.010 wt%, in order to obtain a SiO2-Ti oxide, as for Si concentration, more than 0.5 wt% is needed. However, the increment in Si causes hardening of the quality of the material, and causes degradation of plating nature. the increment in Si concentration -- a steel plate front face -- the bad influence to description becomes large and does not offer the fundamental solution approach.
[0009] Next, in JP,7-47764,B, the non-aging cold rolled sheet steel containing the inclusion of

the low-melt point point which consists of a 17-31wt%MnO-Ti oxide is proposed by deoxidizing so that it may become Ti:0.02 - 1.5 wt% Mn:0.03 - 1.5 wt%. Since in this proposal the above-mentioned MnO-Ti oxide is a low-melt point point, it will be in a liquid phase condition in molten steel and it is poured into mold, without adhering to a nozzle even if molten steel passes a tundish nozzle, lock out of a tundish nozzle can be prevented effectively. However, Yasuyuki Morioka, Hajime Morita trees: It is MnO as it is in the report of iron, steel, 81 (1995), and p.40. : In order to obtain the MnO-Ti oxide contained 17 to 31% It is the ratio of concentration (wt%Mn) of Mn and Ti in [the difference in an affinity with the oxygen of Mn and Ti to] molten steel It is necessary to carry out. / (wt%Ti) >100 Therefore, when Ti concentration in steel is 0.010 wt%, in order to obtain a necessary MnO-Ti oxide, more than 1.0 wt% is required for Mn concentration. However, if Mn content exceeds 1.0 wt%, the quality of the material will harden. Therefore, it was difficult to form the inclusion which consists of a 17-31wt%MnO-Ti oxide in practice.

[0010] Furthermore, it is Ti 3O5 in molten steel by using the ingredient which contains CaO and two grains of ZrO(s) for a nozzle as a preventive measure of lock out of a tundish nozzle in aluminum loess Ti killed steel in JP,8-281394,A. When caught by the nozzle, the approach of making it the low-melt point point inclusion of TiO2-SiO2-aluminum2O3-CaO-ZrO2 system, and preventing the growth is proposed. However, when the oxygen density in molten steel is high, TiO2 concentration of adhesion inclusion becomes high, and in order not to form a low-melt point point, it does not lead to preventing nozzle lock out, but there is a problem a nozzle carries out [a problem] an erosion by one side when an oxygen density is low, and it has not become sufficient cure.

[0011] furthermore, the technique still needs to blow and cast Ar gas and N2 gas in a continuous casting process to the submerged nozzle for pouring in molten steel from a tundish nozzle to mold since [about nozzle plugging prevention of upper **] each **. However, the blown gas was caught by the coagulation shell of a cast piece, and the problem of becoming a cellular defect was left behind.

[0012] By the way, in the case of super-low carbon cold rolled sheet steel, generally, it is widely used as the shell plate and inner plate of an automobile. R value high in especially the part to which dent-proof nature is demanded after press forming (Lankford value) The outstanding printing hardenability is searched for. Among these, depending to the crystal orientation of a steel plate strongly is known, and the above-mentioned r value can be raised by developing {111} recrystallization texture. In order to raise an r value conventionally from this, many things have been examined as the approach of developing {111} recrystallization texture about a steel component, hot-rolling conditions, cold-rolled conditions, and annealing conditions. For example, if recrystallization annealing is performed at an elevated temperature, {111} recrystallization texture progresses strongly and it is known that an r value will go up. However, in the case of this approach, in order to perform elevated-temperature annealing, crystal grain made it big and rough, and the new problem of falling on the contrary produced the direction of on-the-strength elongation balance required for press-forming nature. - A way and printing hardenability are acquired by controlling the dissolution element of the ultralow volume which remained in steel, especially the abundance of Dissolution C. Generally, the amount of dissolution C is the non-oxide Ti Ti* It carries out, and when expressed, it is presumed by the degree type from the amount of stoichiometries.

Amount =C-(12/48) (Ti*-Nx48/14-Sx48/32)-Nbxof dissolution C 12/93, however this are the cases where equilibrium is attained, and are considered to be strongly influenced generally also

by existence (a class, size, amount) of an oxide besides the effect of annealing temperature or a cooling rate.
[0013] In addition, as it is also in the indication of JP,7-47764,B, JP,8-239731,A, etc. about the manufacturing technology of the cold rolled sheet steel for deep drawing using Ti killed steel, for Ti killed steel, an r value is 0.1-0.2 from aluminum killed steel. It is indicated that a high property is acquired. However, these conventional techniques were not examined at all even about grant of printing hardenability, but, moreover, these ingoting methods also had the problem on steel manufacture from the first.
[0014]
[Problem(s) to be Solved by the Invention] This invention makes the trouble which the conventional technique holds and which was mentioned above a solution technical problem. The 1st purpose of this invention is the shape of front planarity, Printing hardenability, It is in proposing the steel plate in which both deep drawability is excellent, and its manufacture approach. To the nozzle plugging prevention at the time of continuous casting, the 2nd purpose of this invention is effective and is to propose the manufacturing technology of deep drawing steel effective also in generation inhibition of cluster-like inclusion. The 3rd purpose of this invention is for an r value to offer further the deep drawing steel which was highly excellent in printing hardenability in addition to the shape of front planarity. And the 4th purpose of this invention is to propose the manufacturing technology of the deep drawing steel for manufacturing the steel plates for surface treatment including cold rolled sheet steel and a hot-dip zinc-coated carbon steel sheet with still better r value and printing hardenability, an electrolytic zinc-coated carbon steel sheet, a tinning steel plate, and a paint steel plate etc. in addition to the shape of front planarity.
[0015]
[Means for Solving the Problem] The oxide system inclusion which remains in steel as a result of repeating research wholeheartedly that the above-mentioned purpose should be attained could carry out the detailed decentralization of the artificers, without moreover making inclusion grow large in the shape of a cluster, without causing nozzle plugging mentioned above, if the size, an amount, and a presentation are specific range, and they hit on an idea of printing hardenability and an r value being sharply improvable to a header and this invention further.
[0016] This invention developed under such knowledge 0.0003wt%<=C<=0.010 wt%, Si<=1.0 wt% and Mn<=3.0 wt% and P<=0.15wt%, S<=0.05wt% and N<=0.01wt%, 0.010wt%<=Ti<=0.50wt%, However, 0.005 among this Ti - 0.05wt% is the non-oxide Ti (Ti*). While containing with a gestalt and including calcium and/or metal REM>=0.0005wt% the following -- (1) A formula or (2) the front face which contains aluminum of the range which fills a formula and is characterized by consisting of the remainder Fe and an unescapable impurity -- description is good and is deep drawing steel which is excellent in printing hardenability. Account wt%Ti/wt%aluminum>=5 .... (1) aluminum<=0.010 wt% and wt%Ti/wt%aluminum<5 -- (2) [0017] In addition, it is still more suitable for the steel plate of this invention to contain any one B:0.0001 - 0.05wt% sort or two sorts other than the above-mentioned component Nb:0.001 - 0.05wt%. Moreover, in this invention, it sets to each above-mentioned steel plate, and is the non-oxide Ti (Ti*). It sets in the relation between Nb (wt%), C (wt%), N (wt%), and S (wt%), and is a degree type.;
The configuration contained so that 0.3 (C/12) <=-(Ti* / 48) (14+S [N /]/32)+(Nb/93) <=1.5 (C/12) may be satisfied is desirable. moreover, the oxide system inclusion which has the magnitude of 50 micrometers or less in each above-mentioned steel plate of this invention --

0.002 - 0.015 wt% -- containing is a desirable configuration. Moreover, it sets to each above-mentioned steel plate of this invention, and the inclusion in steel is CaO. And/or, a REM oxide: They are less than [more than 5wt%50wt%], less than [Ti oxide:90wt%], and aluminum 2O3 at the total quantity. : It is desirable less than [70wt%] or that the oxide system inclusion less than [SiO2:30wt%] and not more than MnO:15wt% is mainly included further.
[0018] Furthermore, this invention as a fundamental component 0.0003wt%<=C<=0.010 wt%, Si<=1.0 wt% and Mn<=3.0 wt% and P<=0.15wt%, S<=0.05wt% and N<=0.01wt%, 0.010 wt%<=Ti<=0.50wt%, However, 0.005 among this Ti - 0.05wt% is the non-oxide Ti (Ti*). While containing with a gestalt and including calcium and/or metal REM>=0.0005wt% Following (1) A formula or (2) The slab containing aluminum of the range which fills a formula It heats at 900-1300 degrees C. - Soak is carried out and finish rolling is ended at the temperature of 650 - 960 **. It rolls round at the temperature of 400 - 750 **. Then, since it cold-rolls with 50 - 95% of rolling reduction, the shape of front planarity characterized by giving recrystallization annealing by 700 - 920 ** is good, and proposes the manufacture approach of deep drawing steel of excelling in printing hardenability.
Account wt%Ti/wt%aluminum>=5 .... (1) aluminum<=0.010 wt% and wt%Ti/wt%aluminum<5 -- (2) [0019] In addition, in the above-mentioned approach concerning this invention, slab serves as a mode of operation with desirable containing any one B:0.0001 - 0.05wt% sort or two sorts other than the above-mentioned fundamental component Nb:0.001 - 0.05wt% further. Moreover, it sets by the all directions method of describing this invention above, and is the above-mentioned non-oxide Ti (Ti*). It sets in the relation between Nb (wt%), C (wt%), N (wt%), and S (wt%), and is a degree type.;
It becomes a desirable configuration to make it contain so that 0.3 (C/12) <=-(Ti* / 48) (14+S [N /]/32)+(Nb/93) <=1.5 (C/12) may be satisfied. Moreover, it sets by the all directions method of describing this invention above, and the inclusion in steel is CaO. And/or, a REM oxide: They are less than [more than 5wt%50wt%], less than [Ti oxide:90wt%], and aluminum 2O3 at the total quantity. : It is desirable less than [70wt%] or that the oxide system inclusion less than [SiO2:30wt%] and not more than MnO:15wt% is mainly included further.
[0020]
[Embodiment of the Invention] The experiment research which first serves as [came to hit on an idea of to this invention] an opportunity is explained. This experiment C:0.002 wt% and Si:0.02wt% and Mn:0.1 wt%, P: 0.01wt% and S:0.006 wt% and aluminum:0.005 wt%, N: 0.002 wt% and Ti:0.02 - 0.04wt%, and O:0.001 - 0.015 wt %, calcium: 0.001 wt%, -(Ti* / 48) (14+S [N/]/32)+Nb / 93**0.8x (C/12) (Ti* : non-oxide Ti) The sheet bar which consists of a component presentation After heating and carrying out soak to 1150 degrees C, finishing temperature 3 pass rolling was performed and it considered as the hot-rolling plate of 4.0mm of board thickness so that it might become 890 degrees C. Then, coil rolling-up processing was performed on the conditions of a 600 ** -1 hour. After that, further, after performing 80% of cold rolling, recrystallization annealing for 880 **-40 seconds was given.
[0021] Drawing 1 shows the effect of the amount of oxides exerted especially on an r value and printing hardenability (BH) about the mechanical property of the steel plate manufactured as mentioned above. Here, the JIS No. 5 test piece for tensile test was used for the r value, it measured it here by law three points, and asked for the average of the r value of three directions, rL (r value of a rolling direction), rC (it is the r value of the direction of a right angle to a rolling direction), and rD (it is the r value of a 45-degree direction to a rolling direction) by r= (rL+rC+2rD) / 4. Moreover, it asked for the tension test as well as an r value by the average of

three directions. Moreover, printing hardenability is JIS. To the No. 5 test piece for tensile test, after [2%] distortion beforehand, the amount of stress rises at the time of performing baking finish by 170 ** for 20 minutes estimated. As a result of carrying out microscope observation of near the steel plate front face about this steel plate, the direction dimension of the board width of the magnitude of the oxide system inclusion of that steel plate was 50 micrometers or less. And in the steel materials of this component presentation system, depending on the amount of oxides, an r value and printing hardenability could reconcile a high r value and high TSxEL, when the amount of oxides was 0.002 - 0.015 wt%, and when especially the amount of oxides was 0.004 - 0.012 wt%, it became clear that a higher r value and printing hardenability were acquired, so that more clearly than this drawing.

[0022] (1) The component presentation of the steel plate concerning steel component this invention ** 0.0003wt%<=C<=0.010 wt% and Si<=1.0 wt%, While calcium and/or metal REM>=0.0005wt% is included N<=0.01wt% and 0.010 wt%<=Ti<=0.50wt% S<=0.05wt% P<=0.15wt% Mn<=3.0 wt% aluminum is contained in the range which fulfills wt%Ti/wt%aluminum>=5 or aluminum<=0.010 wt%, and the conditions of wt%Ti/wt%aluminum<5. ** and the inside Of Above Ti -- thing of the gestalt of a non-oxide (Ti*) 0.005 - 0.05wt% -- containing, ** , and this non-oxide Ti (Ti*) Nb (wt%), Cwt%, and Nwt% and Swt% relation -- setting -- degree type;

The relation of 0.3 (C/12) <=-(Ti* / 48) (14+S [N /]/32)+(Nb/93) <=1.5 (C/12) is filled and contained, ** And further, any one B:0.0001 - 0.05wt% sort or two sorts are contained Nb:0.001 - 0.05wt%, and it is characterized by the remainder consisting of Fe and an unescapable impurity if needed.

[0023] The reason which limited the component presentation of the steel plate concerning this invention as mentioned above hereafter is explained.

(a) 0.0003wt%C<=0.010 wt%C became so good from the top of deep drawability that it is few, and although it was desirable, it was limited to less than [0.010 wt%] as an upper limit out of which takes the load of refinement etc. into consideration and a bad influence does not come. However, since the desired amount of printing hardening is no longer obtained in the amount which is not filled to 0.0003wt%, it is necessary to add 0.0003wt(s)% at least.

(b) Although Si<=1.0 wt%Si has the operation which strengthens steel and made the initial complement contain according to desired reinforcement, since deep drawability deteriorated when the content exceeded 1.0 wt%, it was limited to less than [1.0 wt%].

(c) Although Mn<=3.0 wt%Mn has the operation which strengthens steel and made the initial complement contain according to desired reinforcement, since deep drawability deteriorated when the content exceeded 3.0 wt%, it was limited to less than [3.0 wt%].

(d) Although P<=0.15wt%P has the operation which strengthens steel and made the initial complement contain according to desired reinforcement, since deep drawability deteriorated when the content exceeded 0.15wt(s)%, it was limited to less than [0.15wt%].

(e) Since its deep drawability improved so that there was little S<=0.05wt%S, having lessened was desirable, but since a bad influence did not come out so much when the content was less than [0.05wt%], it was limited to less than [0.05wt%].

(f) Since its deep drawability improved so that there was little N<=0.01wt%N, having lessened was desirable, but since a bad influence did not come out so much when the content was less than [0.01wt%], it was limited to less than [0.01wt%].

(g) 0.010 wt%<=Ti<=0.50wt%Ti is a component which bears the most important role rate in this invention steel plate, by Ti deoxidation, forms detailed oxide system inclusion with a size of 50

micrometers or less, and raises printing hardenability. Furthermore, in order that this detailed oxide may act effective also in detailed-izing of a hot-rolling plate, after cold-rolled-annealing, it develops {111} recrystallization texture and makes an r value high. Since the effectiveness the **** carried out [effectiveness] expected since this Ti content had too little effectiveness of addition, i.e., the amount of a detailed oxide, less than [0.010 wt%] was no longer acquired, the minimum was limited more than 0.010 wt%. This Ti acts more effectively by addition beyond 0.025 wt%. However, since the quality of the material will harden in sheet steel and about [spoiling an expected material property] and a cost rise will also be caused when it adds exceeding 0.50wt%, an upper limit is made into 0.50wt(s)%.

[0024] (h) AlAl is a component which bears an important role rate in this invention, and needs to fulfill the conditions of **wt%Ti/wt%aluminum>=5 or **aluminum<=0.010 wt%, and either of wt%Ti/wt%aluminum<5. if said conditions are no longer fulfilled -- aluminum killed steel -- becoming -- the cluster of huge aluminum 2O3 -- abundant -- generating -- the front face of slab -- since the detailed oxide 50 micrometers or less for controlling the grain growth possibility at the time of cold-rolled-annealing decreases while degrading description, printing hardenability deteriorates. Therefore, aluminum content needs to satisfy the conditions of the above-mentioned ** or **, among these especially the conditions of ** are range desirable when attaining the purpose of this invention.

[0025] (i) the component which bears an important role rate in the steel plate which calcium and/or metal REM>=0.0005wt%calcium, and Metal REM require for this invention -- it is -- any one sort of calcium and REM, or two sorts -- the sum total -- more than 0.0005wt% -- it is necessary to add after [namely,] carrying out Ti deoxidation of the molten steel -- further -- any one sort of calcium and REM, or two sorts -- the sum total -- more than 0.0005wt% -- by adding the oxide presentation in molten steel -- less than [Ti oxide:90wt%] -- desirable -- less than [more than 20wt%90wt%] -- further -- desirable -- less than [85wt%], CaO, and/or more than REM oxide:5wt% -- desirable -- less than [more than 8wt%50wt%] -- it is -- aluminum 2O3 It adjusts so that it may become the oxide system inclusion of the low-melt point point used as less than [70wt%]. If such adjustment is performed, at the time of continuous casting, adhesion for the nozzle of Ti oxide containing a metal can be prevented, and nozzle lock out can be lost. Furthermore, CaO and/or a REM oxide can be contributed to the grain growth after cold-rolled-annealing, and grain refining of a hot-rolling plate. In addition, since addition of superfluous calcium and REM also becomes the cause of bringing about rusting, it is desirable to add in not more than 0.005 wt% with the total quantity.

[0026] (j) non-oxide Ti (Ti *) =0.005 -0.05wt% -- with the 0.3 (C/12) <=-(Ti* / 48) (14+S [N /]/32)+(Nb/93) <=1.5 (C/12) non-oxide Ti It exists as Ti which does not exist in the state of an oxide in steel among all Ti, i.e., carbide, a nitride, a sulfide, etc., or the total amount of Ti which exists in the state of dissolution is meant, and it asks by the following approach.

amount of non-oxide Ti = -- all the amount of Ti-oxides Ti -- here, it is O concentration (wt%) by EPMA of Ti concentration (wt%) / inclusion in steel by EPMA of oxide Ti= all the inclusion in amount [of O] x steel. And Ti concentration and O concentration by EPMA select at random ten 3-10-micrometer oxide system inclusion which exists in steel, and measure concentration by EPMA, and the average is used for them. In this way, the non-oxide Ti for which it asked is a component which bears a very important role rate in the steel plate concerning this invention, and is a part of dissolution C in steel, Dissolution N While preventing degradation of deep drawability by carrying out deposit immobilization as carbide, a nitride, and a sulfide, and reducing Dissolution S, there is effectiveness which gives printing hardenability by making C of

a minute amount remain in the state of dissolution. Even if the amount is ineffective less than [0.005 wt%] and exceeded 0.05wt(s)% on the other hand, the effectiveness beyond it was not acquired, but since it led to deep drawability degradation conversely, it was limited with 0.005 - 0.05wt%. and this non-oxide Ti (Ti *) an amount is set in a relation with Nb, C, N, and S each content -- 0.3 (C/12) <=-(Ti* / 48) (14+S [N /]/32)+(Nb/93) <=1.5 (C/12) It is necessary to satisfy relational expression. namely, 0.3 (C/12) >-(Ti* / 48) (14+S [N/]/32)+ (Nb/93) **** -- in order that a lot of dissolution C may remain in a hot-rolling plate, although printing hardenability is satisfactory, it is inferior in the deep drawability after cold-rolled-annealing. On the other hand, the non-oxide Ti of the amount of -(Ti */48) (14+S [N/]/32)+(Nb/93) > 1.5 (C/12) In order to degrade printing hardenability, it is 0.3 (C/12) <=-(Ti* / 48) (14+S [N /]/32)+(Nb/93) <=1.5 (C/12). It limited.

[0027] (k) Nb:0.001 -0.05wt%Nb is effective in raising the r value after cold-rolled-annealing by making the organization of a hot-rolling plate detailed. The addition effectiveness does not have the addition less than [0.001 wt%], and it is one side. Since Dissolution C is fixed completely and printing hardenability was no longer acquired while the effectiveness of addition was saturated and leading to degradation of deep drawability conversely even if it added exceeding 0.1wt%, it limited to the range of 0.001 - 0.05wt%.

(l) Although added for the improvement of the fabricating-proof brittleness of steel, since B:0.0001-0.05wt%B led to degradation of deep drawability conversely when the addition does not have the addition effectiveness less than [0.0001wt%] and added exceeding 0.05wt(s)% on the other hand, it was limited to 0.0001 - 0.05wt%.

[0028] (2) the detailed oxide system inclusion which has the magnitude of 50 micrometers or less about the steel plate of slab and inclusion this invention of a steel plate with the dimension of the steel plate cross direction (the direction of a rolling right angle) -- 0.002 - 0.015 wt% -- to adjust so that it may contain is required. By the way, the dimension of the inclusion which exists in slab (slab) hardly changes with rollings in the direction of the board width, although it elongates in a rolling direction. Therefore, in order to maintain the inclusion dimension of the steel plate cross direction within the limits of predetermined, it is necessary to control an inclusion dimension by the slab phase. For this reason, control of the detailed oxide system inclusion contained in slab is one of the important components of this invention. especially as for the inclusion generated under this invention approach, width of face (the direction dimension of a rolling right angle) has the magnitude of 50 micrometers or less -- it is the oxide system inclusion of granular or the letter of fracture. If width of face is oxide system inclusion 50 micrometers or less, grain refining at the time of hot-rolling and the grain growth at the time of cold-rolled-annealing can be controlled. However, there is no effectiveness like the above at inclusion with larger width of face than 50 micrometers. From this, width of face limited this oxide system inclusion to the thing 50 micrometers or less. Moreover, since deep drawability deteriorated conversely when there is no effectiveness in grain growth with few contents than 0.002 wt% and it contained mostly rather than 0.015 wt% on the other hand, this oxide system inclusion was limited to 0.002 - 0.015 wt%. In addition, from a viewpoint of deep drawability, 0.004 - 0.012 wt% of the content of oxide system inclusion is desirable. Here, granular oxide system [when the comparatively small thing is maintaining the form by saying the oxide system inclusion of the letter of granular or the fracture the oxide system inclusion of the letter of fracture is the oxide system inclusion generated with steel slab, and the comparatively big thing was divided by whose rolling direction in hot-rolling and cold-rolling] inclusion in which width of face has the magnitude of 50 micrometers or less is said.

[0029] (3) The manufacture approach steel-manufacture process of a steel plate : in the case of this invention, especially this process is not limited, but it illustrates a desirable art below. A material is super-low carbon steel, and it is necessary to make it into Ti>=0.010 wt%, and it needs to ingot the steel which has the component presentation with which the conditions of **wt%Ti/wt%aluminum>=5 or **aluminum<=0.010 wt%, and either of wt%Ti/wt%aluminum<5 are filled. In this case, at Ti<0.010 wt%, deoxidation capacity is weak, all the oxygen densities in molten steel become high, and the reason for making Ti as an adjustment component Ti>=0.010 wt% is elongation, It is for material properties, such as a diaphragm, to get worse. However, although raising the concentration of Si and Mn and increasing the deoxidation force even in this case is also considered, at Ti<0.010 wt%, SiO2 or MnO content inclusion generates in large quantities, and causes hardening of the steel quality of the material, and degradation of plating nature. In order to prevent this, it is / (wt%Ti) (wt%aluminum) >=5. (wt%Mn) / (wt%Ti) <100 Carrying out is desirable and Ti oxide concentration in inclusion becomes 20% or more in this case.

[0030] Moreover, the reason made into the conditions of **wt%Ti/wt%aluminum>=5 or **aluminum<=0.010 wt%, and either of wt%Ti/wt%aluminum<5 serves as aluminum killed steel instead of Ti killed steel on the conditions with which these conditions are not filled, and is aluminum 2O3. Concentration is 70% or more of aluminum 2O3. It is because a cluster generates in large quantities. In the inclusion which makes Ti oxide a subject for inclusion, this invention makes CaO and a REM oxide contain, and tends to attain the desired end so that it may mention later. It is desirable to adjust to the conditions of **wt%Ti/wt%aluminum>=5 especially among this point and the two above-mentioned conditions.

[0031] Molten steel is deoxidized with Ti content alloys, such as Fe-Ti, and the oxide system inclusion which makes Ti oxide a subject into steel is made to generate first in manufacture of the steel plate concerning this invention. The inclusion is huge the shape not of a cluster but grain with a magnitude of about 1-50 micrometers like [when deoxidizing with aluminum], The thing of the letter of fracture occupies many. However, when it separates from the conditions of the above-mentioned ** or ** at this time, it is huge aluminum 2O3. A cluster generates. Such aluminum 2O3 Even if it adds Ti alloy and increases Ti concentration, it cannot return, but a cluster remains as cluster-like inclusion in steel. Therefore, about the steel plate concerning this invention, it is the phase of this manufacture and it is desirable to make it make Ti oxide suitable in molten steel generate first.

[0032] In addition, under this invention method, since the yield of Ti alloy is bad and calcium and REM are moreover contained compared with the conventional approach deoxidized with aluminum, the alloy for inclusion presentation adjustment is expensive. As for the addition from this to the inside of the molten steel of this Ti alloy, it is economical to carry out so that it may be little as much as possible and may end within limits which can presentation control inclusion, and it is desirable. It sets in this semantics and is dissolved oxygen in molten steel before addition of deoxidation material, such as Ti content alloy, In order to reduce FeO in slab, and MnO, it is desirable to carry out preliminary deoxidation. Addition of the deoxidation, Si and FeSi by little aluminum which becomes aluminum<=0.010 wt% in the molten steel after deoxidation, Mn, or FeMn performs this preliminary deoxidation.

[0033] As mentioned above, the inclusion the steel plate which generated Ti oxide system inclusion of 2O3>=70% of Ti generated by Ti deoxidation In order to distribute in steel in the magnitude which is about 2-20 micrometers, the surface discontinuity by cluster-like inclusion is lost. However, in molten steel, Ti oxide is in a solid phase condition, and grows up to be the

inside of a tundish nozzle in the form where the metal was incorporated since super-low carbon steel had the high coagulation temperature of steel, and has a possibility of inducing lock out of a nozzle.

[0034] Any one sort of calcium and REM or two sorts are added. then, this invention -- if it is, after deoxidizing with Ti alloy -- further -- so that it may become more than 0.0005wt% the oxide presentation in molten steel, as a result a steel plate -- less than [more than Ti oxide:20wt%90wt%] -- desirable -- less than [85wt%] -- CaO and/or, REM oxide: -- more than 5wt% -- desirable -- less than [more than 8wt%50wt%] and aluminum 2O3 It considers as the oxide system inclusion of the low-melt point point which is less than [70wt%]. If it does so, it will become possible to prevent effectively adhesion for the nozzle of Ti oxide which incorporated the metal. In addition, the presentation of more desirable inclusion is Ti 2O3. : Less than [more than 30wt%80wt%], CaO, REM oxide s (La 2O3, Ce 2O3, etc.) It is less than [more than :10wt%40wt%]. Less than [20wt%], Ti oxide of the above-mentioned inclusion serves as aluminum killed steel instead of Ti killed steel, and it is aluminum 2O3. Since rusting will get worse if nozzle plugging occurs and CaO and REM oxide concentration become high, since concentration increases, Ti oxide concentration is made more than 20wt%. On the other hand, more than at 90wt%, since there are little CaO and REM oxide and nozzle plugging occurs, Ti oxide concentration makes Ti oxide concentration less than [more than 20wt%90wt%].

[0035] Moreover, aluminum 2O3 in the above-mentioned inclusion If it attaches, since it will become a high-melting presentation if 70wt% is exceeded, nozzle lock out not only occurs, but the configuration of inclusion becomes cluster-like and the defect of the nonmetallic inclusion nature in a product plate increases.

[0036] the oxide system inclusion in steel [in / as mentioned above / this invention] -- CaO and/or, a REM oxide -- the total quantity -- less than [more than 5wt%50wt%] and Ti oxide -- less than [90wt%] and aluminum 2O3 less than [70wt%] -- it mainly needs to be concerned with contained Ti oxide. In the above-mentioned oxide system inclusion, oxides other than said oxide, such as SiO2 and MnO, can be included further. In this case, about the content of SiO2 in the above-mentioned inclusion, controlling less than [15wt%] is [MnO / less than / 30wt% / and] desirable. Even if this reason cannot be said to be target titanium killed steel by this invention if these exceed each amount, and it does not perform calcium addition under such a presentation, nozzle plugging is because there is nothing and the problem of rusting is also lost. And in order to make SiO2 and MnO contain in inclusion as mentioned above, it is desirable to set Si of molten steel and Mn concentration to Mn/Ti>100 and Si/Ti>50. in addition -- the inside of the oxide of this invention -- ZrO2 and MgO etc. -- making it mix in not more than 5 wt% is permitted. In addition, the presentation of the oxide system inclusion in the steel explained above shall extract ten oxide system inclusion to arbitration, and shall calculate it from the average (analysis value).

[0037] If it is in the steel plate concerning this invention, compared with the conventional steel which carried out aluminum deoxidation, the yield of Ti alloy is bad and becomes expensive from adding calcium and REM. If adjusting so that it may end with the smallest possible amount can perform presentation control of the inclusion in steel by being desirable from this, the dissolved oxygen concentration in the molten steel before Ti deoxidation will be 200 ppm. It is desirable to carry out preliminary deoxidation so that it may become below. This preliminary deoxidation is molten steel stirring in a vacuum, and deoxidation by little aluminum. (aluminum after deoxidation is less than [0.010 wt%] among molten steel) It is desirable to carry out by deoxidation by Si, FeSi, Mn, or FeMn.

[0038] The dimension of the inclusion controlled as mentioned above shall have the magnitude of 50 micrometers or less. Here, by the deoxidizing method which the reason which limits the magnitude of inclusion to a thing 50 micrometers or less requires for this invention, inclusion 50 micrometers or more is hardly generated. Generally as for inclusion 50 micrometers or more, the inclusion of this of the foreignness of a slag, mold powder, etc. is because it is the main factor. moreover, the amount of inclusion of 50 micrometers or less -- more than 80wt% of the oxide system inclusion whole quantity -- it is desirable when making it exist prevents the surface discontinuity and nozzle plugging of a coil.
[0039] In this invention, when the presentation of the inclusion to generate is controlled as mentioned above, it can prevent completely that an oxide etc. adheres to a tundish nozzle and the submerged nozzle inside of mold at the time of continuous casting. It becomes unnecessary therefore, to blow Ar for antisticking, such as an oxide, and the gas of N2 grade into tundish or a submerged nozzle. Consequently, the effectiveness that it can prevent that the powder nature defect of a cast piece by the powder contamination at the time of continuous casting and the cellular defect by the blown gas occur in a cast piece is acquired.
[0040] Hot-rolling process: Perform heating of slab performed in advance of hot rolling at the temperature of 900-1300 degrees C. In whenever [below 900 ** / slab stoving temperature], the load load at the time of rolling becomes high too much, and the problem on operation produces this reason. On the other hand, at the high temperature exceeding 1300 degrees C, since the diameter of crystal grain before rolling becomes large too much, a hot-rolling plate does not make it detailed. Therefore, whenever [slab stoving temperature] is limited to 900-1300 degrees C. In addition, whenever [this slab stoving temperature] has desirable 1200 degrees C or less from a viewpoint of deep drawability. In addition, it can be said to be a desirable approach from a viewpoint of energy saving to adopt CC-DR (continuous casting-direct rolling) or HCR (hot charge rolling) in the processing applied to rolling from continuous casting.
[0041] Termination temperature of the above-mentioned hot rolling is made into 650 - 960 **. After this reason ends hot rolling at temperature higher than 960 **, the crystal grain of a hot-rolling plate makes it big and rough, and the deep drawability after cold-rolled-annealing deteriorates. On the other hand, since it will lead to increase of a rolling load if the temperature is lower than 650 ** although hot rolling may be ended in alpha region of the 3 or less transformation point of Ar(s), finish rolling termination temperature is limited to 650 - 960 **. In addition, although the coil rolling-up temperature after hot rolling is as advantageous to big-and-rough-izing of a sludge as an elevated temperature, since a sludge will not make it big and rough if less [if 750 ** is exceeded, problems, like a scale becomes thick too much will arise, and] than 400 **, it is limited to the range of 400 - 750 **.
[0042] Cold-rolling process: This process is processing which obtains a high r value and which is performed for accumulating, and in order to attain this purpose, it needs to make cold-rolled rolling reduction into 50 - 95%. Because, if rolling reduction is not filled to 50%, since it is because the outstanding deep drawability is not obtained, the high r value beyond it is not obtained even if it cold-rolls with 95% or more of rolling reduction on the other hand, but an r value falls conversely, it will limit to 50 - 95%.
[0043] Annealing process: The cold rolled sheet steel which passed through the cold rolling process needs to give recrystallization annealing. Annealing temperature It considers as 700-920 **. Because, {111} with annealing temperature desirable to deep drawability at under 700 ** recrystallization texture does not progress, and predetermined printing hardenability is not acquired. On the other hand, even if it performs annealing by the pyrosphere exceeding 920 **, it

is because the deep drawability beyond it is not obtained, but texture randomizes it by alpha->gamma transformation conversely and an r value deteriorates. Therefore, annealing temperature It limits to 700 - 920 **. And to the steel strip after annealing, 10% or less of temper rolling may be applied for adjustments, such as configuration correction and surface roughness.
[0044] In addition, the cold rolled sheet steel obtained by doing in this way is applicable also as a negative of the surface treated steel sheet for processing only as cold rolled sheet steel for processing. As the surface treatment, it is a galvanization. (an alloy system is included) There are a tinning, enamel resin covering, etc. Moreover, to this invention steel plate, special processing may be performed after annealing or a galvanization, and chemical conversion nature, weldability, press-forming nature, corrosion resistance, etc. may be improved to it.
[0045]
[Example] The example of invention: While carrying out decarbonization processing of the molten steel of 300ton in RH degassing apparatus after converter tapping and adjusting to S:0.003 - 0.008 wt% P:0.010 - 0.060wt% Mn:0.06 - 0.45wt% Si:0.004 - 0.120 wt% C:0.0012 - 0.0021wt%, molten steel temperature was adjusted to 1585-1615 degrees C. the inside of this molten steel -- aluminum -- 0.2 - 0.8 kg/ton addition -- carrying out -- the dissolved oxygen concentration in molten steel -- 55 - 250 ppm up to -- it was made to fall aluminum concentration in the molten steel at this time was 0.001 - 0.003 wt%. And to this molten steel, it is a 70wt%Ti-Fe alloy. 0.8-1.8 kg/ton addition was carried out and Ti deoxidation was carried out. after [then,] adding FeNb, FeB, etc. and performing a quality governing -- the inside of molten steel -- a 30wt%calcium-60wt%Si alloy and it -- Met. -- Fe covering wire of calcium alloys, such as an additive which mixed calcium, Fe5 - 15wt% REM, or a 90wt%calcium-5wt%nickel alloy, and a REM alloy -- 0.05 - 0.5 kg/ton It processed by adding. For Ti concentration after this processing, aluminum concentration was [the REM concentration of calcium concentration] 0.0000 - 0.0020wt% 0.0005 - 0.0018wt% 0.001 - 0.003 wt% 0.026 - 0.058 wt%.
[0046] This molten steel was cast in 2 strand slab continuous casting equipment, and continuous casting slab was manufactured. In addition, the average organization of the inclusion of the molten steel in tundish at this time is 25-85wt%Ti2O3-5-45wt%CaO-0-18wt%REM oxide-6-41wt%aluminum 2O3. It was detailed spherical inclusion. At the time of this casting, Ar gas was not blown into tundish and a submerged nozzle. When observed after continuous casting, there was almost no affix into tundish and a submerged nozzle.
[0047] Next, after hot-rolling the above-mentioned continuous casting slab, it cold-rolls to 0.8 mm, and it is continuous-annealing Rhine (CAL) further. Or hot-dip-zincing Rhine (CGL) Recrystallization annealing was performed. A steel presentation is shown in Table 1 and the average presentation of the content of oxide system inclusion and the inclusion in main steel plates 1 micrometers or more is shown in Table 2. Here, values, such as the non-oxide Ti and a mechanical property, were calculated like the approach mentioned above. In addition, all the direction sizes of the board width of the amount of oxide system inclusion at this time were 50 micrometers or less. And hot-rolling, cold-rolling, and the monograph affair and mechanical property of annealing are shown in Table 3. As for the defect of nonmetallic inclusion nature, such as HEGE, a sleeve, and a scale, below 0.00-0.02 pieces / 1000m-coil were accepted in this annealing plate. In addition, it was satisfactory as well as [the amount of rusting] the conventional aluminum deoxidation. Moreover, electroplating and the surface quality of the steel plate which performed hot-dip-zincing processing were also good after cold rolling.
[0048]
[Table 1]

[0049]
[Table 2]

	鋼板の成分 (wt%)													備考
	C	Si	Mn	P	S	Al	Ti	Ti/Al	Ca	REM	N	Nb	B	
A	0.0015	0.015	0.13	0.011	0.003	0.002	0.024	12.0	0.0006	−	0.0021	−	−	発明例
B	0.0012	0.120	0.12	0.010	0.004	0.003	0.024	8.0	0.0005	−	0.0020	0.005	0.0004	発明例
C	0.0013	0.015	0.25	0.060	0.003	0.001	0.018	18.0	0.0010	−	0.0019	0.007	0.0010	発明例
D	0.0020	0.004	0.12	0.012	0.005	0.002	0.022	11.0	0.0009	−	0.0024	0.007	−	発明例
E	0.0021	0.004	0.06	0.012	0.005	0.003	0.030	10.0	0.0018	−	0.0022	0.005	0.0005	発明例
F	0.0017	0.015	0.10	0.013	0.006	0.003	0.025	8.3	0.0007	0.0020	0.0020	0.005	−	発明例
G	0.0015	0.006	0.15	0.020	0.005	0.035	0.019	0.5	−	−	0.0018	0.003	0.0005	比較例

	50μm以下の非金属系介在物量 (wt%)	酸化物系介在物組成 (wt%)						非酸化Ti	X*	コイルの欠陥量 個/1000m	備考
		CaO	REM酸化物	Ti酸化物	Al_2O_3	SiO_2	MnO				
A	0.005	7	0	85	6	2	0	0.016	0.7	0	発明例
B	0.0052	8	0	84	7	1	0	0.017	1.4	0	発明例
C	0.0041	18	0	60	22	0	0	0.013	0.4	0	発明例
D	0.0034	10	0	69	20	0	0	0.017	0.2	0	発明例
E	0.0128	21	0	59	19	1	0	0.018	0.4	0.02	発明例
F	0.0049	9	17	63	11	0	0	0.020	0.6	0	発明例
G	0.0014	0	0	2	98	0	0	0.018	0.7	0.45	比較例

* X= (Ti* /48-N/14-S/32+Nb/93)/(C/12)
非酸化Ti=Ti*

[0050]
[Table 3]

No.	鋼	製造条件						機械的特性					備考
		熱延条件			冷延率	焼鈍ライン	焼鈍温度	YS	TS	El	r値	BH	
		SRT (℃)	FDT (℃)	CT (℃)	(%)		(℃)	(MPa)	(MPa)	(%)		(MPa)	
1	A	1130	900	600	80	CAL	880	140	310	51	2.1	45	発明例
2	A	1150	900	600	80	CAL	680	250	345	33	1.0	25	比較例
3	B	1200	890	600	80	CAL	850	180	338	47	2.0	47	発明例
4	B	1200	900	600	45	CAL	880	195	351	39	1.0	39	比較例
5	C	1150	880	600	80	CAL	940	180	320	38	1.1	47	比較例
6	C	1120	895	600	80	CAL	780	145	310	52	2.2	43	発明例
7	D	1150	980	600	80	CAL	830	140	305	47	1.5	38	比較例
8	D	1100	905	600	80	CAL	880	135	308	51	2.1	49	発明例
9	E	1100	900	600	80	CGL	800	148	310	50	2.2	47	発明例
10	F	1200	900	600	80	CAL	800	130	305	53	2.0	47	発明例
11	G	1150	895	600	80	CAL	850	148	290	47	1.8	39	比較例

[0051] The example of a comparison: While carrying out decarbonization processing of the molten steel of 300ton in RH degassing apparatus after converter tapping and adjusting to S:0.005 wt% P:0.020 wt% Mn:0.15wt% Si:0.006 wt% C:0.0015wt%, molten steel temperature was adjusted to 1590 degrees C. Into this molten steel, 1.2 -1.6 kg/ton addition of the aluminum was carried out, and deoxidation processing was performed. aluminum concentration in the molten steel after deoxidation processing was 0.035 wt%. Then, while adding Fe-Ti, Fe-Nb and Fe-B were added and the component presentation was adjusted. In addition, Ti concentration after this processing was 0.040 wt%. Next, the above-mentioned molten steel was cast in 2 strand slab continuous casting equipment, and continuous casting slab was manufactured. in addition, the average presentation of the inclusion contained in the molten steel in tundish at this time -- 95-98wt%aluminum 2O3 and Ti 2O3 not more than 5wt% from -- the inclusion of the shape of a becoming cluster was a subject. It is aluminum 2O3 to a nozzle remarkably [when Ar gas is not blown into tundish and a submerged nozzle at the time of casting]. It adhered, the opening of a sliding nozzle increased to 3 charge eye remarkably, and nozzle plugging stopped cast. Moreover, also when Ar gas is played, in a nozzle, it is aluminum 2O3. It had adhered in large quantities, fluctuation of the surface of hot water in mold became large at 8 charge eye, and cast was stopped. Next, after hot-rolling the above-mentioned continuous casting slab to 4.0 mm, it was cold-rolled to 0.8 mm and performed recrystallization annealing further in continuous-annealing Rhine. A steel presentation is shown in Table 1 and the content of oxide system inclusion and the average presentation of inclusion 1 micrometers or more are shown in Table 2. Moreover, manufacture conditions and a mechanical property are shown all over Table 3. In this annealing plate, the defect of nonmetallic inclusion nature, such as HEGE, a sleeve, and a scale, is 0.45 piece / 1000m-coil private seal ****.

[0052]

[Effect of the Invention] As explained above, the steel plate concerning this invention does not cause lock out of an immersion nozzle in manufacture of this at the time of continuous casting, and, moreover, the front face of rolling sheet steel is deep drawing steel that there is almost no surface discontinuity resulting from nonmetallic inclusion, and very pure. Since it has a still higher r value and the outstanding on-the-strength elongation balance, it is used very suitably as sheet steel for automobiles etc.

[Translation done.]